

THURSDAY, SEPTEMBER 28, 1882

MODERN PHYSICS

The Concepts and Theories of Modern Physics. By J. B. Stallo. (London: Kegan Paul, Trench, and Co., 1882.)

THIS is, in many respects, a curious work. It shows very extensive reading, as well as much patient thought, on the part of its author; and is, throughout, eminently "readable," although somewhat disfigured by the use of strange and uncommon words, such as "questionability," "irrecusable," "luminar," "consilientes," &c., and even of words apparently made for the occasion. With engaging frankness, the author tells us in the Preface that a previous work of his was written when he

"was under the spell of Hegel's ontological reveries:—at a time when I was barely of age and still seriously affected with the metaphysical malady which seems to be one of the unavoidable disorders of intellectual infancy. The labour expended in writing it was not, perhaps, wholly wasted, and there are things in it of which I am not ashamed, even at this day; but I sincerely regret its publication, which is in some degree atoned for, I hope, by the contents of the present volume."

His recovery from this direful malady has been unusually complete; but the *sequelæ* are still of a somewhat distressing character, for the work is "designed as a contribution, not to physics, nor, certainly, to metaphysics, but to the theory of cognition."

Having been himself at one time enchanted in the Circean sty of metaphysics, the author now sees the evil thing everywhere rampant, and specially in scientific writings. With a subtlety which is occasionally almost admirable, he seems to endeavour, under cover of perfect candour and confidence along with intense zeal for the interests of science, to insinuate into the reader's mind doubts of the validity of some of the most fundamental of scientific hypotheses and reasonings. We rise from a perusal of his volume with a feeling of dawning doubt, which happily vanishes the moment we attempt to find a justification for it. We can, however, fancy some ardent student, unversed in laboratory work and with no great knowledge of physical principles, falling an easy victim to the doubts here suggested; the author all the while smiling grimly to himself as did the spirit of negation when his admiring victim exclaimed—

... mir wird so dumm
Als geh' mir ein Mühlrad im Kopf herum.

This insidious weakening of the student's faith in principles and methods is perhaps even more dangerous to scientific progress than what the author in his Preface speaks of as

"the shallow and sciolistic materialism—I allude, of course, not to its supposed ethical but to its purely intellectual aspects—which for a time threatened to blight the soil and poison the atmosphere even of the old highlands of thought on the continent of Europe, [and which] claims to be a presentation of conclusions from the facts and principles established in the several departments of physical science."

The author is seen at his best and also at his worst in the Chapters on the "Kinetic Theory of Gases;" and the whole character and tendencies of his work will be

easily gathered by any one who carefully peruses the following extracts from that chapter. To these we need scarcely add a word of comment:—

"It thus appears that the pre-supposition of absolute elasticity in the solids, whose aggregate is said to constitute a gas, is a flagrant violation of the first condition of the validity of an hypothesis—the condition which requires a reduction of the number of unrelated elements in the fact to be explained, and therefore forbids a mere reproduction of this fact in the form of an assumption, *a fortiori* a substitution of several arbitrary assumptions for one fact. Manifestly the explanation offered by the kinetic hypothesis, in so far as its second assumption lands us in the very phenomenon from which it starts, the phenomenon of resilience, is (like the explanation of impenetrability, or of the combination of elements in definite proportions by the atomic theory) simply the illustration of *idem per idem*, and the very reverse of a scientific procedure. It is a mere *versatio in loco*—movement without progress. It is utterly vain; or rather, inasmuch as it complicates the phenomenon which it professes to explicate, it is worse than vain:—a complete inversion of the order of intelligence, a resolution of identity into difference, a dispersion of the One into the Many, an unravelling of the Simple into the Complex, an interpretation of the Known in terms of the Unknown, an elucidation of the Evident by the Mysterious, a reduction of an ostensible and real fact to a baseless and shadowy phantom."

"It were work of supererogation to review in detail the logical and mathematical methods by which it is attempted, from an hypothesis resting on such foundations, to deduce formulæ corresponding to the facts of experience. I may be permitted to say, however, that the methods of deduction are only less extraordinary than the premisses. To account for the laws of Boyle and Charles, resort is had to the calculus of probabilities, or, as Maxwell terms it, the method of statistics. It is alleged that, although the individual molecules move with unequal velocities, either because the velocities were originally unequal, or because they have become unequal in consequence of the encounters between them, nevertheless, there will be an average of all the velocities belonging to the molecules of a system (*i.e.* of a gaseous body) which Maxwell calls the 'velocity of mean square.' The pressure, on this supposition, is proportional to a product of the square of this average velocity into the number of the molecules multiplied by the mass of each molecule. The product of the number of molecules into the mass of each molecule is then replaced by the density—in other words, the whole molecular assumption is, for the nonce, abandoned—and the velocity is eliminated as representing the temperature; it follows, of course, that the pressure is proportional to the density."

"Similar procedures lead to the law of Charles and the 'law' of Avogadro (according to which the number of molecules in any two equal volumes of gases of whatever kind is the same at the same temperatures and pressures—a law which is itself a mere hypothesis). It is claimed, on statistical grounds again, that not only the average velocity of a number of molecules in a given gaseous body is the same, but that 'if two sets of molecules, whose mass is different, are in motion in the same vessel, they will, by their encounters, exchange energy with each other till the average kinetic energy of a single molecule of either set is the same.'"

"This," says Maxwell, "follows from the same investigation which determines the law of distribution of velocities in a single set of molecules." All this being granted, the law of Charles and the law of Avogadro (called by Maxwell the law of Gay-Lussac) are readily derived. And at the end of these devious courses of deduction Maxwell adds a disquisition on the properties of the molecules, in which he claims to have made it evident that the mole-

cules of the same substance are 'unalterable by the processes which go on in the present state of things, and every individual of the same species is of exactly the same magnitude as though they had all been cast in the same mould, like bullets, and not merely selected and grouped according to their size, like small shot,' and that, therefore, as he expresses it in another place, they are not the products of any sort of evolution, but, in the language of Sir John Herschel, 'have the essential character of manufactured articles.'

"Now, on what logical, mathematical, or other grounds is the statistical method applied to the velocities of the molecules in preference to their weights and volumes? What reason is given, or can be given, why the masses of the molecules should not be subjected to the process of averaging as well as their motions? None whatever. And, in the absence of such reason, the deductions of the kinetic theory, besides being founded on rickety premisses, are delusive paralogisms."

"Upon these considerations I do not hesitate to declare that the kinetic hypothesis has none of the characteristics of a legitimate physical theory. Its premisses are as inadmissible as the reasoning upon them is inconclusive. It postulates what it professes to explain; it is a solution in terms more mysterious than the problem—a solution of an equation by imaginary roots of unknown quantities. It is a pretended explanation, of which it were unmerited praise to say that it leaves the facts where it found them, and is obnoxious to the old Horatian stricture: '*nil agit exemplum, litem quod lite resolvit*.'"

"It may seem strange that so many of the leaders of scientific research, who have been trained in the severe schools of exact thought and rigorous analysis, should have wasted their efforts upon a theory so manifestly repugnant to all scientific sobriety—an hypothesis in which the very thing to be explained is but a small part of its explanatory assumptions. But even the intellects of men of science are haunted by pre-scientific survivals, not the least of which is the inveterate fancy that the mystery by which a fact is surrounded may be got rid of by minimising the fact and banishing it to the regions of the extra-sensible. The delusion, that the elasticity of a solid atom is in less need of explanation than that of a bulky gaseous body, is closely related to the conceit that the chasm between the world of matter and that of mind may be narrowed, if not bridged, by a rarefaction of matter, or by its resolution into forces. The scientific literature of the day teems with theories in the nature of attempts to convert facts into ideas by a process of dwindling or subtilisation. All such attempts are nugatory; the intangible specter (*sic*) proves more troublesome in the end than the tangible presence. Faith in spooks (with due respect be it said for Maxwell's thermo-dynamical 'demons' and for the population of the 'Unseen Universe') is unwisdom in physics no less than in pneumatology."

"*Pure Being* is simply the specter (*sic*) of the copula between an extinct subject and a departed predicate." It is a pity that a man who can so smartly show up the absolute nonsense of the professed metaphysicians (past and present alike) should weaken the force of his really valuable remarks by attacking in a similar style some of the best-ascertained truths of mathematical and of physical science. We repeat that the volume is lively reading, that its smartness is visible in every page, but that its author (having once been bitten by metaphysics) has, in his desire to save others, run a-muck not merely through gossamer webs but also against stone walls. No doubt he has done good:—some of the supposed stone walls he has encountered have proved to be mere stage "proper-

ties." But the reader cannot fail to doubt the validity of a method which upsets with equal ease the most irrefragable truth and the most arrant nonsense.

P. G. T.

OUR BOOK SHELF

Amazulu; the Zulus, their Past History, Manners, Customs, and Language, with Observations on the Country, and its Productions, Climate, &c.; the Zulu War, and Zululand since the War. By the Rev. T. B. Jenkinson. (London: W. H. Allen and Co., 1882.)

THE Rev. Thomas B. Jenkinson, having been a missionary in Natal between the years 1873-79, proposes to give us his experiences of the country and its people in a work bearing the above ambitious title. But so little information is to be gleaned from its pages on these subjects that the judicious reader will do well to begin and end with the short appendix, which contains a few remarks on the present political situation of Zululand. This appendix consists of extracts from two letters not written by Mr. Jenkinson, and nearly the whole of the book is found to be made up in the same way of quotations from diaries and private letters written by the missionary or members of his family to friends in England, or else of stale passages from the *Cape Argus*, Livingstone's journals, *Macmillan's Magazine*, or the diaries of other missionaries, who flourished half a century ago. Thus the section devoted to "Historical Notices of the Zulu Nation" consists largely of extracts from the journal of the Rev. Francis Owen, originally published in the *Missionary Register* for 1838! Deducting these wholesale appropriations, the actual amount of text attributable to the compiler will occupy a very small portion of the work. This, however, may be regarded as fortunate, for the quantity is not compensated by the quality of the composition, which is written in a crude, jerky style, and made up mainly of trivial incidents of missionary life. The contributions to science and history are remarkable, as, for instance, the statement that "the British exchanged Java for St. Helena with the Dutch!" (54); that the Zulus are somehow connected with Israel, although they seem to be descended from Ham, "still a common name among them" (33); that the Zulu language "resembles" the Hebrew (18); that in Natal there is a curious animal "called a rock-coney rabbit, a rhinoceros in miniature!" (8); and that Mr. Jenkinson "killed ten of those large rock-pigeons with one shot" (188).

A. H. K.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Lighthouses

IN Dr. Siemens's inaugural address to the British Association, reported in *NATURE*, vol. xxvi. p. 398, reference is made to the system originally suggested by Sir William Thomson some years ago, "of distinguishing one light from another by flashes following at varied intervals."

Now in Sir William's article "On the Lighthouses of the Future," in *Good Words*, March 1873, it is shown that the proposal to distinguish lighthouses from each other by diverse groups of occultations had been made by Charles Babbage at least so early as 1851; while, more recently, Capt. Colomb had adopted intervals of unequal length for a code of signals corresponding to the Morse Telegraph Alphabet. This, however, was, as I understand, for ships' night signals, and not for lighthouse purposes.